the same as that due to a current of strength m flowing along the short line joining the source to the sink. Now the current at any point produced by a source and sink placed close together at a distance ds, is exactly the same as the magnetic force at the same point produced by a magnet joining the source and sink, whose moment is $m\,ds$, and direction of magnetisation along the line joining the source and sink. Hence if we have any system of currents in the field, and find by the application of the methods given by Sir W. Thomson in his paper on "Inverse Problems" the distribution of magnetism which would produce a magnetic field such that the magnetic force at any point was equal in magnitude and direction to the current at the point, the magnetic action of the system of currents will by the proposition just stated be the same as that due to currents whose intensity and direction coincide with the intensity and direction of the magnetisation producing the said magnetic field. Thus instead of currents occupying the whole of the medium, we have only to consider currents occupying a limited portion of it. This is, we think, all that can be fairly stated about this point, and it will be seen that, to say the least, Prof. Rowland's statement that "the action in such a medium reduces itself to an action between magnets and electromotive forces instead of between magnets and currents," is not a clear way of putting it. Prof. Rowland in this part of the subject introduces a new term, viz., magneto-motive force; this is a force supposed to exist between two magnetic poles so as to cause the same number of lines of induction to pass between the points as to flow out of either of them; it is proportional to the magnetisation, and seems only introduced for the sake of making more evident the fact that currents are related to electromotive forces like lines of induction to magnetisation, or with the new terminology to magneto-motive forces. This was pointed out by Maxwell in his paper on "Faraday's Lines of Force" published in the Cambridge *Transactions* for 1856.

The last part of the paper, which is also the most interesting, contains the explanation, by means of the new action discovered by Mr. Hall, of the magnetic rotation of the plane of polarisation of light. By adding to the old expression of the electromotive force a term representing the force discovered by Mr. Hall, Prof. Rowland obtains an expression for the rotation of the plane of polarisation of exactly the same form as the one given by Maxwell in § 829 of the "Electricity and Magnetism."

J. J. THOMSON

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—The report of the Botanic Garden Syndicate states that during the past year valuable additions have been made to the collections of ferns and orchids, and many choice stove and greenhouse plants have been received. The collection of hardy, herbaceous, and alpine plants has been much increased, and the rockery furnished with many rare alpine species. The genera Iris, Narcissus, and Helleborus have received special attention. During the year, 1594 labels have been written in large letters. The curator, Mr. Lynch, has extended the correspondence of the Gardens with botanic gardens, nurserymen, and private cultivators: 2600 plants have been received, and 1285 packets of seeds.

In consequence of the decision of the Duke of Devonshire in favour of the legality of the recent vote of the Senate admitting women to the Previous and the Tripos Examinations, the first lists in which the names of women who have passed the Previous and any Tripos Examination, have appeared in the University *Reporter*. In the Natural Sciences Tripos, Part 1, Class 2, is the name of Miss Anelay of Girton. In the Previous Examination twelve Girton students and two Newnham students have passed in one or more parts of the examination.

LOCAL LECTURES.—In spite of the removal of several important districts from the scope of these lectures by the establishment of local colleges, the numbers attending lectures during the past winter have been 4369 as against 5009 in the preceding winter; and the reduction in numbers is due to the absence of the South Wales centre from the lists, the Syndicate having been unable to make adequate arrangements for this district, owing to their engagements elsewhere. South Wales is again to be vigorously worked in the coming session. Dr. R. D. Roberts of Clare College has been appointed Assistant Secretary for the purposes of the local lectures. The courses of lectures on physical science subjects in the past winter have included Mr. Teall's on Early Man in Western Europe, and the Origin of Rocks and Scenery of the British Isles at Nottingham and Derby, Mr. J. E. Marr's on Geology at Carlisle and Penrith, Mr. E. Carpenter's on the Science and History of Music at Nottingham, and on Light at Chesterfield, Mr. Carr Robinson on Gases and on Chemistry at Hull, and by Mr. H. N. Read on Botany at the Crystal Palace.

SCIENTIFIC SERIALS

Journal of the Franklin Institute, June.—The flight of birds and the mechanical principles involved, by A. C. Campbell.—Recent advances in photography, negative and positive, by J Carbutt.

Journal de Physique, June.—On registering apparatus for atmospheric electricity and terrestrial magnetism, by M. Mascart.—On radiophony (third memoir), by M. Mercadier.—On the contraction of galvanic deposits and its relation to Peltier's phenomenon, by M. Bouty.—Projection of the Lissajous figures with differences of phase variable at will, by M. Crova.—Production of electric currents in any system of fixed conducting wires, by M. Brillouin.

Reale Istituto Lombardo di Scienze e Lettere. Rendiconti. Vol. xiv. fasc. viii.-ix.—On the question whether American vines may be imported from phylloxerised or suspected districts without risk, by Count Trevisan.—Difference of longitude between the observatories of Genoa, Milan, Naples, and Padua, by Prof. Celoria.—On the stocking of Italian lakes with fishes, by Prof. Pavesi and Dr. Sulzer.—Toradelphia of a scorpion, by Prof. Pavesi.—Monstrosity of a fresh-water Crustacean (*Astacus fluviatilis*), by Prof. Maggi.—Cremation and legal medicine, by Dr. Biffi.

Rivista Scientifico-Industriale, No. 9, May 15.—Two new applications of the electric light, by Prof. Ferrini.—Mercury air-pump, by S. Serravalle.—New method of qualitative chemical analysis, by L. Mauri.

Atti della R. Accademia dei Lincei, vol. v. fasc. 12.—Description of a terrestrial *trombe* which occurred in 1456, by S. Blaserna.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, June 16.—"On the Reversal of the Lines of Metallic Vapours. No. VIII. (Iron, Titanium, Chromium, and Aluminium.)" By Professors Liveing and Dewar.

In their last communication on this subject the authors observed that iron introduced as metal or as chloride into the electric arc in a lime crucible in the way which had proved successful in the case of many other metals, gave no reversals. They succeeded however in reversing some ten of the brightest lines of iron, mostly in the blue and violet, by passing an iron wire through one of the carbons, so as to keep up a constant supply of iron in the arc. Considering the great number of iron lines, and that so many of them are strongly represented amongst the Fraunhofer lines, it seemed somewhat surprising that it should be difficult to obtain a reversing layer of iron vapour in the arc inclosed in an intensely heated crucible. A like remark might be made respecting titanium, which is almost as well represented as iron in the Fraunhofer lines, but has heretofore given no reversals. Almost the same might be said of chromium, except that the number of chromium lines is so much less than that of either of the other two metals.

They have since found that most, if not all, of the strong lines of these three metals may be reversed by proper management of the atmosphere and supply of metal in the crucible. Indeed with regard to iron the method employed with other metals was successful so far as the ultra-violet rays were concerned, though it failed for less refrangible rays. When iron has been put into the crucible through which the arc of a Siemens' dynamo-electric machine is passing, and then fragments of magnesium dropped in from time to time, most of the strong ultra violet lines of iron are reversed. The magnesium seems to supply a highly reducing atmosphere, and to some extent carry with it the iron vapour. It also produces a good deal of continuous spectrum, at least in certain regions, and against this the iron lines are often depicted on the photographic plates sharply reversed. In this way the authors have observed the reversal of the strong

iron lines about the solar lines L and M, four strong lines below N, the line O, all the strong lines from S_2 to U inclusive, and two strong groups still more refrangible.

Potassium ferrocyanide introduced into the arc instead of magnesium gives a reversal of the same lines as are mentioned in the foregoing paragraph.

Iron wire fed in through a perforated pole gives reversals of the highest group (wave-length 2492 to 2480), but with the lines so much expanded as to form broad absorption-bands instead of lines.

With a vertical arrangement of the carbons and a stout iron wire in the axis of the lower (positive) carbon, many more lines in the visible part of the spectrum are seen expanded and reversed. This effect is sometimes enhanced by leading into the crucible through the upper carbons, which is perforated for the purpose, a very gentle stream of hydrogen gas; the stream must be no more than is just sufficient to give a tiny flame at the the mouth of the crucible; a stronger stream diminishes the amount of metallic vapour, probably by its cooling action, and lessens the effect. By this treatment some of the strongest lines of iron remain reversed for some time, the weaker lines are seen to expand and be reversed for a few seconds at a time, when, from a change in the intensity of the current, or some other reason, a larger amount of metal is volatilised and shows itself by burning in brilliant scintillations at the mouth of the crucible.

A list of the iron lines reversed, 136 in number, designated by their approximate wave-lengths, is given in the paper.

When the perforation of the lower carbon is filled with titanium cyanide instead of the iron wire the titanium lines come out very brilliantly and steadily, and many of them, especially in the green and blue parts of the spectrum, are expanded and reversed. A list of twenty-nine lines observed to be reversed is given in the paper.

In the case of chromium, introduced into the crucible either as oxide or as bichromate of ammonia, there were no reversals until a gentle current of hydrogen or of coal gas was led in through the perforated carbon. This brought out the triplet in the green, wave-lengths 5207, 5205, 5203, sharply and steadily reversed, and likewise the three strong lines in the indigo, wave-lengths 4289, 4274, 4253; also a triplet near N at wave-lengths about 3578, 3593, 3606, apparently coincident with strong lines in Cornu's map of that part of the solar spectrum, and a rather strong double line just below O at about wave-length 3446. The reversal of another chromium line at about wave-length 3217 is doubtful. A triplet at wave-lengths 2799·8, 2797, 2794, is more easily reversed than any other of the chromium lines. This triplet is generally strongly developed whenever a compound of chromium is introduced into the crucible, so that the authors conclude that it is due to that metal, but it is sometimes visible in the photographs when other chromium lines are not seen. A still more refrangible chromium line, wave-length about 2779·6, is also frequently reversed by a gentle current of hydrogen.

The two aluminium lines near S are frequently reversed when a fragment of the metal is dropped into the crucible, the less refrangible line, wave-length 3091·5, being more strongly reversed, and continuing reversed for a longer time than that at wave-length 3080·5.

Chemical Society, July 16.—Prof. Roscoe, president, in the chair.—The following papers were read:—On the isomeric acids obtained from coumarin and the ethers of salicylic aldehyde, by W. H. Perkin. The author has studied the action of various agents on these bodies. The α body (from coumarin) is converted into the β body by heat or light. In general the effect of chemical action on the α acid is to convert it into the same compound as that yielded by the β body. Bromine forms an exception, and two isomeric dibromides were obtained. The author concludes that as the α body has a lower boiling-point, density, refractive index, and is less stable than the β acid, it is probable that its molecules are farther apart and that the difference of distance is probably between the radical and the hydroxyl. The derivatives from propionic and butyric coumarin were studied.—Notes on naphthalene derivative, by H. E. Armstrong and G. Lowe. The authors have continued their investigations as to the action of sulphuric acid on naphthalene, and confirm their previous statement that three and not two disulphonic acids may be obtained. An isomeric β naphtholsulphonic acid was prepared by dissolving β naphthol in cold concentrated sulphuric acid.—On the synthesis of ammonia, by G. S. Johnson. The author reasserts that pure nitrogen, free from nitric oxide, when passed with hydrogen over spongy platinum, forms ammonia. If however the nitrogen be previously passed through red hot asbestos no ammonia is formed. This indicates the existence of an active allotropic nitrogen analogous to ozone.—On the alkaloids of nux vomica, by W. A. Shenstone. The author has prepared pure brucine, but concludes that the so-called Igasurin has no existence.—Notes on photographs of the ultra-violet emission spectra of certain elements, by W. N. Hartley.—On the sulphates of aluminium, by S. U. Pickering.—On two new oxides of bismuth, by M. M. P. Muir, Bi_2O_7 and Bi_4O_7, prepared by the action of aqueous potassium cyanide on a hot nitric acid solution of bismuth nitrate.

Royal Microscopical Society, June 8.—The president, Prof. P. Martin Duncan, F.R.S., in the chair.—Eleven new Fellows were elected and proposed.—Prof. Paul Reinsch attended the meeting and exhibited specimens of the vegetable forms found by him in the Coal measures.—The president read a paper on some remarkable enlargements of the axial canal in sponge spicula and their causes, accompanied by drawings on the blackboard. Nearly all the spicula obtained from specimens of very deep soundings off Japan were found to have the normal axial canal enlarged in a moniliform or conoidal manner, producing very elegant results. The spicula were of seven or eight kinds, and were mature. The enlargement was found to be invariably accompanied by an open condition of the axial canal or by penetrations, cylindrical in outline, from without, down to the canal. The penetrations were shown to be connected with an organic body resembling the zoospores of an *Achlya*, and granules, organic in nature, were observed within the enlarged canals. Thinning and solution of the spicula, the result of these organisms, were considered, and admitting the influence of great pressure, the president stated that he had never seen anything which led him to believe that there was free carbonic acid gas in the ocean.—A note was read by Dr. Savage calling attention to the changes which took place in nervous tissues in the process of hardening.—Mr. Holmes read a paper on a new British Alga, specimens of which were exhibited.—Discussions also took place on the value of swinging sub-stages on the motion of diatoms.—Dr. Maddox exhibited some micro-photographs of diatoms, and Mr. Powell demonstrated the aperture of his $\frac{1}{8}$-inch oil-immersion objective = 1·47 num. ap., the largest hitherto made.

Physical Society, June 25.—Prof. Fuller in the chair.—Señor Olympio de Barcelos was elected a member.—Mr. Grant exhibited an apparatus for showing the position and direction of the curve of zero electro-dynamic induction. It consisted of two coils of insulated wire mounted on stands, one being fixed while the other was free to revolve round it at a fixed distance.—Prof. W. E. Ayrton explained the determination of the refractive index of ebonite made by himself and Prof. Perry. The result for oxy-hydrogen light was 1·7, but at the suggestion of Prof. Fitzgerald of Dublin this was checked by measuring the polarising angle of ebonite by reflected light. Sunlight was employed in these experiments, and different pieces of ebonite. The result was 1·611. Professors Ayrton and Perry had repeated their former experiments, using the electric light and a battery of 70 volts E.M.F. The result confirmed the one first obtained. They had also determined the index of refraction in the ordinary way from the red rays, which they observed to pass through the prism of ebonite. Result for the least refrangible rays 1·66. Mr. Boys remarked that one could see better through thin ebonite if it was varnished or wetted than when untreated.—A letter was read by the chairman from a sub-committee of the British Association inviting the members of the Society to send exhibits to the jubilee meeting of the British Association at York.—Dr. James Moser read a paper on the microphonic action of selenium cells, in which he argued that the action of the selenium cell in the photophone was that of a microphonic contact or bad joint between the metal electrodes or metal plates of the cell and the selenium. The heat rays of the photophonic beam caused the joint to expand and contract; hence the variation in the current passing through the receiving telephone. Dr. Moser also exhibited a piece of selenium which increased, not diminished, in electric resistance when light fell upon it. He further showed a standard Daniell cell of the gravity type, which consisted of a glass vessel containing the copper plate at the bottom immersed in sulphate of copper solution, and the zinc plate at the top immersed in sulphate of zinc solution, and a clear line of demarcation between these solutions was produced by suspending an independent piece of zinc midway between the plates, so as to decompose all the sulphate of copper which diffused upward to that point.

Prof. Mcleod said that he had produced the same result by surrounding the zinc plate with a cage of copper wire connected to the copper plate. Copper deposited on the cage and the cell was in constant use. Dr. Lodge said that arrangement would not however serve as a standard of electromotive force, because all the copper plate should be in the copper solution. In his cell the copper and solution are both in a test-tube immersed in the zinc solution, and diffusion has to take place up this test-tube and down the cell so as to enter a second tube, open at the bottom, in which the zinc is placed.—Dr. Guthrie showed a new experiment to the effect that when a magnet is suspended over a disk of copper and the disk is rotated the magnet is repelled upwards. The experiment was shown by suspending a horse-shoe magnet from one end of a scale beam, counterweighted. As a possible explanation he suggested that the vertically-resolved force of the induction-current before the magnet might be greater than that behind the magnet.—The Secretary read a paper by Prof. Balfour Stewart and Mr. W. Strode, on results obtained by a modification of Bunsen's calorimeter described to the Society in January last year. With a new instrument made by Casella they have determined the mean specific heat of iron to be 0·1118, and that of sulphur 0·1756, the true values being given as 0·1138 and 0·1776. The advantage of the method is its simplicity, and the fact that very small quantities of the substance may be used.—Dr. Lodge then explained experiments by Mr. Sutherland, showing that a Daniell cell keeps its E.M.F. very constant when heated, because the thermo-electric effect at the junction of the zinc with the solution is balanced by that at the junction of the copper with the solution. After remarks by Dr. Moser and Prof. Perry, the Society separated until November next.

PARIS

Academy of Sciences, June 20.—M. Wurtz in the chair.—The following papers were read:—Observations on the simultaneous reduction of two bilinear forms, by M. Jordan.—On the preparation of aldol, by M. Wurtz.—Fresh discovery of native sulphur in the soil of Paris, by M. Daubrée. This occurred during the laying of drains in the rue Meslay. The case seems very similar to that previously recorded.—On a new thermograph, by M. Mercadier. The instrument consists of a cylindrical brass reservoir prolonged into a capillary tube of red copper, which opens into a Bourdon tube. The whole is filled with oil, and closed. The dilatation or contraction of the oil with varying temperature affects the curvature of the Bourdon tube, and thereby a recording lever. Two such instruments may be used simultaneously to give the curves for a deep and a peripheric part of the body. It is proved that in vaso-motor disorders the animal temperature undergoes variations in opposite directions in the central and peripheric parts. Inanition cools both the centre and periphery, while certain maladies seem to increase the production of heat, for they heat both parts.—On M. Roudaire's project of the interior sea; reply to M. Cosson, by M. de Lesseps.—On osseous grafts, by M. Ollier. He calls attention to Mr. MacEwen's success (in Glasgow) in reconstituting a portion of the humeral diaphysis by means of six cuneiform bony fragments taken from the tibias of young children having rachitic incurvations. The osseous tissue was transplanted complete. The antiseptic method was employed. (A note by Mr. MacEwen describes his mode of procedure).—Microscopic phenomena of muscular contraction; transversal striation of smooth fibres, by M. Rouget. It is demonstrated that this striation (which occurs only in the state of contraction) is due to the fibre when it contracts getting folded on itself, and then presenting alternate projections and depressions. The fibre-cells in polarised light are uniformly bi-refringent in the smooth state, but in the state of contraction they show in the dark field an alternation of bright and dark bands. It is shown from smooth fibres of the adductor-muscle of the valves in a cephalous molluscs killed by heat, that a fibre which has lost all contractility may still acquire all the peculiarities of structure and optical characters of striated fibres, if any cause produce in it fine and regular folds.—On the thermal laws of the excitative spark of condensers, by M. Villari. The heat developed by this spark (which is that produced against the exciter) is proportional to the quantity of electricity multiplied by the electric thickness, or it is proportional to the quantity of electricity for the fall of potential.—On the heat of formation of oxychloride of calcium, by M. André.—Action of protoxide of lead on alkaline iodides, by M. Ditte.—On the basic carbonates of lime, by M. Raoult. The property of hardening in contact with water is observed in all basic carbonates obtained by heating any lime, pure or not, in carbonic acid, and it is this that chiefly characterises that class of compounds.—Influence of concentration of hydrochloric acid on the dissolution of chloride of silver, by MM. Ruyssen and Varenne. The decrease of solubility as the acid is diluted is rapid and regular. The insolubility seems approximately to be tripled as the titre of the acid is halved.—Action of arsenic and phosphoric acids on tungstates of soda, by M. Lefort.—Researches on tertiary monamines; action of heat on bromide of allyltriethylammonium, by M. Reboul.—On the microzymas of chalk; reply to MM. Chamberland and Roux, by M. Béchamp.—Studies on the coal-formation of Commentry; its formation attributed to transport in a deep lake, by M. Fayol. He here criticises adversely the theory of primitive horizontality of the deposits with general subsidences of the ground. The natural explanation is transport without subsidence. Important industrial interests depend on arriving at an exact theory of formation of coal strata.—M. Daubrée presented the first volume of *Annals* of the School of Mines of Ouro-Preto, sent by the Emperor of Brazil in name of M. Gorceix. This describes some of the mineral riches of Brazil.—M. Tabourin communicated a project for the electric light: he would place in the pedestal supporting the carbons a small magneto-electric machine driven by the force of water in pipes, or by compressed air, or by descent of a weight.

VIENNA

Imperial Academy of Sciences, June 17.—L. T. Fitzinger in the chair.—T. Exner, examinations into the localisation in the cortex cerebri of man.—A. Rollett, on the action of salts and sugar on the red-blood corpuscles.—L. Boltzmann, contributions to the theory of viscosity of gases.—On some theorems relating to heat-equilibrium, by the same.—Ign. Klemencic, on the deadening vibrations of solid bodies in liquids.—Dr. K. Friesach, on the transits of Mercury and Venus in 1881 and 1882.—G. Haberlandt, on the collateral vessels in the leaves of ferns.—T. Herzig, contributions to the knowledge of trigenic acid.—A note on cyanuric biuret, by the same.—H. Fürth, on berberonic acid and the products of its decomposition.—G. Goldschmidt, on some new aromatic hydrocarbons.—C. Senhofer, on the direct action of carboxyl groups on phenols and aromatic acids.—C. Senhofer and F. Salay, on the action of hydroquinone on potassium dicarbonate.—C. Brunner, on the action of tolu-hydroquinone on potassium dicarbonate.—T. Zehenter, on some derivates of α-dioxybenzoic acid.—D. T. Woldrich, second report on the diluvial fauna of Zuzlawitz near Winterberg (Bohemia).—T. Pernter, on the daily and yearly course of atmospheric pressure on mountain-summits and in Alpine valleys.

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